

Claims:

1. A removal tool for a locking nut and bolt system, said locking nut and bolt system including a bolt with a bolt thread and a nut with a nut thread in an internal passageway complementary to said bolt thread, a plurality of notches on said bolt thread, said nut carrying a locking body having an elongated tine with a proximal tine body portion attached to said locking body and a distal tine end protruding into said internal nut passageway and adapted to ride on said bolt thread and fall into at least one of said plurality of notches dependent upon a relative position of said distal tine end and said plurality of notches, said removal tool comprising:

    a body with first and second ends, said first end configured and dimensioned to be received within said internal passageway of said nut and including a number of prongs,

    wherein each prong is adapted to be located intermediate said proximal tine body portion of said elongated tine and said bolt thread upon insertion of said first end in said internal passageway such that rotation of said body lifts said distal tine end away from said plurality of notches.

2. A removal tool as claimed in claim 1 wherein said body has a cylindrical shape.

3. A removal tool as claimed in claim 2 wherein said first end of said body includes a plurality of cut-outs defining said prongs.

4. A removal tool as claimed in claim 3 wherein there are three prongs.

5. A removal tool as claimed in claim 1 wherein said second end of said body is coupled to a head plate.

6. A removal tool as claimed in claim 5 wherein said body has a cylindrical shape and said head plate has a diameter larger than said second end diameter.

7. A removal tool and locking nut and bolt combination comprising:

    a bolt with a bolt thread having a plurality of notches on said bolt thread;

    a nut with a nut thread about a nut bore having an axial centerline, said nut thread complementary to said bolt thread;

    a locking element operatively associated with said nut and having a locking element bore coaxial with respect to said axial centerline, said locking element including an elongated tine with a proximal tine body portion attached to said locking element and a distal tine end protruding inward toward said axial centerline and adapted to ride on said bolt thread and fall into at least one of said plurality of notches dependent upon a relative position of said distal tine end and said plurality of notches; and

    a removal tool including a body with first and second ends, said first end configured and dimensioned to be received within said locking element bore and including a number of prongs, wherein each prong is located intermediate said proximal tine body portion of said elongated tine and said bolt thread upon insertion of said first end in said locking element bore such that rotation of said body lifts said distal tine end away from said plurality of notches.

8. A combination as claimed in claim 7 wherein said locking element is carried on said nut.

9. A combination as claimed in claim 8 wherein:

    said nut has an end face with a recess thereon and said nut thread includes an axial keyway;

    said locking element has a cylindrical shape and includes a radial key extending therefrom which is complementary to said nut keyway; and

    said locking element mounts in said recess beneath said end face of said nut with said insert key being disposed in said nut keyway.

10. A combination as claimed in claim 9 wherein said tine extends an axial length of said locking element and said key extends the axial length of said locking element such that radially compressive forces and rotational and counter-rotational forces are longitudinally distributed throughout said locking element via said key to said nut keyway.

11. A combination as claimed in claim 9 wherein said nut keyway extends only part way through said nut thread.

12. A combination as claimed in claim 9 wherein said nut end face has a radially inward extending lip and an annular groove behind said lip, said annular groove sized to closely capture said locking element therein with said lip engaging an end face of said locking element.

13. A combination as claimed in claim 8 wherein:

    said nut has an end face with a recess thereon; and

    said locking element is formed as a cylinder and having an axially rearward ring member disposed in said nut recess and said locking element protruding from said nut end face.

14. A combination as claimed in claim 13 wherein movement of said distal tine end is visible due to disposition of said locking element on said end face of said nut.

15. A combination as claimed in claim 13 wherein said rearward ring of said locking element includes one of a key and a keyway, said nut recess defining one of a complementary keyway and key whereby said locking element is keyed to a predetermined position with respect to said nut by alignment of said key and complementary keyway.

16. A combination as claimed in claim 13 wherein said nut end face includes a swage mount at said axially rearward ring member.

17. A combination as claimed in claim 13 wherein said axially rearward ring member includes at least one cut out and said nut end face includes a swage mount at said axially rearward ring member.

18. A combination as claimed in claim 7 further comprising an S-shaped member having first, second and third elongated, generally planar legs, wherein said nut is formed on one of said second and third legs and said locking element is formed on the other of said second and third legs.

19. A combination as claimed in claim 7 further comprising a U- or J-shaped clip member having first and second elongated, generally planar legs, wherein said nut is formed on said first leg and said locking element is formed on said second leg.

20. A combination as claimed in claim 19 wherein said nut thread is a single thread having an arc less than 360 degrees.

21. A combination as claimed in claim 7 further comprising a U-shaped member having first and second elongated, generally planar legs, wherein said nut thread is formed as a single thread on said first leg and having an arc less than 360 degrees and said locking element is formed on said first leg beyond said arc of said nut thread and on said nut bore.

22. A combination as claimed in claim 21 wherein said second leg is truncated.

23. A combination as claimed in claim 21 wherein said second leg defines a bore coaxial with said axial centerline.

24. A removal tool for a locking nut and bolt system, said locking nut and bolt system including a bolt with a bolt thread and a nut with a nut thread in an internal passageway complementary to said bolt thread, a plurality of notches on said bolt thread, said nut carrying a locking body having an elongated tine with a proximal tine body portion attached to said locking

body and a distal tine end protruding into said internal nut passageway and adapted to ride on said bolt thread and fall into at least one of said plurality of notches dependent upon a relative position of said distal tine end and said plurality of notches, said removal tool comprising:

    a cylindrical latch having first and second ends and a side surface;

    a plurality of legs axially extending from said first end of said latch; and

    a user actuatable control surface radially extending from said side surface of said latch,

    wherein said cylindrical body is adapted to be disposed atop said locking body and said bolt thread whereby one of said legs is placed intermediate said proximal tine body portion of said elongated tine and said bolt thread and said cylindrical body is rotated thereby lifting said distal tine end away from said plurality of notches.

25. A removal tool as claimed in claim 24 further comprising a socket having open and closed ends and a sidewall defining a cavity, said latch substantially housed within said cavity.

26. A removal tool as claimed in claim 25 wherein said sidewall of said socket has a slot, said user actuatable control surface extending through said slot and rotatable within said slot.

27. A removal tool as claimed in claim 26 wherein said closed end includes a female socket fitting.

28. A removal tool and locking nut and bolt combination comprising:

    a bolt with a bolt thread having a plurality of notches on said bolt thread;

    a nut with a nut thread about a nut bore having an axial centerline, said nut thread complementary to said bolt thread;

    a locking element operatively associated with said nut and having a locking element bore coaxial with respect to said axial centerline, said locking element including an elongated tine with

a proximal tine body portion attached to said locking element and a distal tine end protruding inward toward said axial centerline and adapted to ride on said bolt thread and fall into at least one of said plurality of notches dependent upon a relative position of said distal tine end and said plurality of notches; and

a removal tool including a cylindrical latch having first and second ends and a side surface, a plurality of legs axially extending from said first end of said latch, and a user actuatable control surface radially extending from said side surface of said latch,

wherein said cylindrical body is adapted to be disposed atop said locking body and said bolt thread whereby one of said legs is placed intermediate said proximal tine body portion of said elongated tine and said bolt thread and said cylindrical body is rotated thereby lifting said distal tine end away from said plurality of notches.

29. A combination as claimed in claim 28 wherein said locking element is carried on said nut.

30. A combination as claimed in claim 29 wherein:

    said nut has an end face with a recess thereon and said nut thread includes an axial keyway;  
    said locking element has a cylindrical shape and includes a radial key extending therefrom which is complementary to said nut keyway; and  
    said locking element mounts in said recess beneath said end face of said nut with said insert key being disposed in said nut keyway.

31. A combination as claimed in claim 30 wherein said tine extends an axial length of said locking element and said key extends the axial length of said locking element such that radially

compressive forces and rotational and counter-rotational forces are longitudinally distributed throughout said locking element via said key to said nut keyway.

32. A combination as claimed in claim 30 wherein said nut keyway extends only part way through said nut thread.

33. A combination as claimed in claim 30 wherein said nut end face has a radially inward extending lip and an annular groove behind said lip, said annular groove sized to closely capture said locking element therein with said lip engaging an end face of said locking element.

34. A combination as claimed in claim 29 wherein:

    said nut has an end face with a recess thereon; and

    said locking element is formed as a cylinder and having an axially rearward ring member disposed in said nut recess and said locking element protruding from said nut end face.

35. A combination as claimed in claim 34 wherein movement of said distal tine end is visible due to disposition of said locking element on said end face of said nut.

36. A combination as claimed in claim 34 wherein said rearward ring of said locking element includes one of a key and a keyway, said nut recess defining one of a complementary keyway and key whereby said locking element is keyed to a predetermined position with respect to said nut by alignment of said key and complementary keyway.

37. A combination as claimed in claim 34 wherein said nut end face includes a swage mount at said axially rearward ring member.

38. A combination as claimed in claim 34 wherein said axially rearward ring member includes at least one cut out and said nut end face includes a swage mount at said axially rearward ring member.

39. A combination as claimed in claim 28 further comprising an S-shaped member having first, second and third elongated, generally planar legs, wherein said nut is formed on one of said second and third legs and said locking element is formed on the other of said second and third legs.

40. A combination as claimed in claim 28 further comprising a U- or J-shaped clip member having first and second elongated, generally planar legs, wherein said nut is formed on said first leg and said locking element is formed on said second leg.

41. A combination as claimed in claim 40 wherein said nut thread is a single thread having an arc less than 360 degrees.

42. A combination as claimed in claim 28 further comprising a U-shaped member having first and second elongated, generally planar legs, wherein said nut thread is formed as a single thread on said first leg and having an arc less than 360 degrees and said locking element is formed on said first leg beyond said arc of said nut thread and on said nut bore.

43. A combination as claimed in claim 42 wherein said second leg is truncated.

44. A combination as claimed in claim 42 wherein said second leg defines a bore coaxial with said axial centerline.

45. A removal tool for a locking nut and bolt system, said locking nut and bolt system including a bolt with a bolt thread and a nut with a nut thread in an internal passageway complementary to said bolt thread, a plurality of notches on said bolt thread, said nut carrying a locking body having an elongated tine with a proximal tine body portion attached to said locking body and a distal tine end protruding into said internal nut passageway and adapted to ride on said bolt thread and fall into at least one of said plurality of notches dependent upon a relative position of said distal tine end and said plurality of notches, said removal tool comprising:

a cylindrical body with an open end carrying a plurality of axially movable, axially outwardly biased, depending legs disposed about said open end at circumferential positions complementary to said bolt thread;

wherein said cylindrical body is adapted to be disposed atop said locking body and said bolt thread whereby one of said depending legs is placed intermediate said proximal tine body portion of said elongated tine and said bolt thread and said cylindrical body is rotated thereby lifting said distal tine end away from said plurality of notches.

46. A removal tool as claimed in claim 45 wherein said depending legs are captured within guide channels formed on said cylindrical body near said open end.

47. A removal tool as claimed in claim 46 wherein said depending legs are axially biased outward by a spring.

48. A removal tool as claimed in claim 47 wherein each depending leg moves independently with respect to each other.

49. A removal tool as claimed in claim 45 including an outer cylinder complementary to said cylindrical body, said cylindrical body movably disposed inside said outer cylinder, and including a user actuatable control surface protruding from said cylindrical body through a hole in said outer cylinder whereby said cylindrical body is rotated with respect to said outer cylinder based upon movement of said control surface.

50. A removal tool as claimed in claim 49 wherein said hole forms a partial spiral arc such that said cylindrical body rotates and moves axially outboard based upon the movement of said control surface with respect to said outer cylinder.

51. A removal tool as claimed in claim 49 wherein said outer cylinder includes a female socket fitting at an opposing end which is opposite said open end of said cylindrical body.

52. A removal tool and locking nut and bolt combination comprising:

a bolt with a bolt thread having a plurality of notches on said bolt thread;

a nut with a nut thread about a nut bore having an axial centerline, said nut thread complementary to said bolt thread;

a locking element operatively associated with said nut and having a locking element bore coaxial with respect to said axial centerline, said locking element including an elongated tine with a proximal tine body portion attached to said locking element and a distal tine end protruding inward toward said axial centerline and adapted to ride on said bolt thread and fall into at least one of said plurality of notches dependent upon a relative position of said distal tine end and said plurality of notches; and

a removal tool including a cylindrical body with an open end carrying a plurality of axially movable, axially outwardly biased, depending legs disposed about said open end at circumferential positions complementary to said bolt thread;

wherein said cylindrical body is adapted to be disposed atop said locking body and said bolt thread whereby one of said depending legs is placed intermediate said proximal tine body portion of said elongated tine and said bolt thread and said cylindrical body is rotated thereby lifting said distal tine end away from said plurality of notches.

53. A combination as claimed in claim 52 wherein said locking element is carried on said nut.

54. A combination as claimed in claim 53 wherein:

said nut has an end face with a recess thereon and said nut thread includes an axial keyway;  
    said locking element has a cylindrical shape and includes a radial key extending therefrom  
    which is complementary to said nut keyway; and

    said locking element mounts in said recess beneath said end face of said nut with said insert  
    key being disposed in said nut keyway.

55. A combination as claimed in claim 54 wherein said tine extends an axial length of said  
    locking element and said key extends the axial length of said locking element such that radially  
    compressive forces and rotational and counter-rotational forces are longitudinally distributed  
    throughout said locking element via said key to said nut keyway.

56. A combination as claimed in claim 54 wherein said nut keyway extends only part way  
    through said nut thread.

57. A combination as claimed in claim 54 wherein said nut end face has a radially inward  
    extending lip and an annular groove behind said lip, said annular groove sized to closely capture said  
    locking element therein with said lip engaging an end face of said locking element.

58. A combination as claimed in claim 53 wherein:  
    said nut has an end face with a recess thereon; and  
    said locking element is formed as a cylinder and having an axially rearward ring member  
    disposed in said nut recess and said locking element protruding from said nut end face.

59. A combination as claimed in claim 58 wherein movement of said distal tine end is  
    visible due to disposition of said locking element on said end face of said nut.

60. A combination as claimed in claim 58 wherein said rearward ring of said locking element  
    includes one of a key and a keyway, said nut recess defining one of a complementary keyway and

key whereby said locking element is keyed to a predetermined position with respect to said nut by alignment of said key and complementary keyway.

61. A combination as claimed in claim 58 wherein said nut end face includes a swage mount at said axially rearward ring member.

62. A combination as claimed in claim 58 wherein said axially rearward ring member includes at least one cut out and said nut end face includes a swage mount at said axially rearward ring member.

63. A combination as claimed in claim 52 further comprising an S-shaped member having first, second and third elongated, generally planar legs, wherein said nut is formed on one of said second and third legs and said locking element is formed on the other of said second and third legs.

64. A combination as claimed in claim 52 further comprising a U- or J-shaped clip member having first and second elongated, generally planar legs, wherein said nut is formed on said first leg and said locking element is formed on said second leg.

65. A combination as claimed in claim 64 wherein said nut thread is a single thread having an arc less than 360 degrees.

66. A combination as claimed in claim 52 further comprising a U-shaped member having first and second elongated, generally planar legs, wherein said nut thread is formed as a single thread on said first leg and having an arc less than 360 degrees and said locking element is formed on said first leg beyond said arc of said nut thread and on said nut bore.

67. A combination as claimed in claim 66 wherein said second leg is truncated.

68. A combination as claimed in claim 66 wherein said second leg defines a bore coaxial with said axial centerline.